

# ARCHITECTURE

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IN OUR country where permanent examples of monumental architecture are few and far between, the various expositions which have been held in recent years have had a decided influence upon contemporaneous architecture. To many of our people from the rural sections of the country these efforts in staff and iron have been the sole examples of imposing structures that they have been able to see. The architectural im-

pressions that they have made upon the public mind have been positive and to a great extent lasting, and the designers of such expositions therefore take upon themselves the serious duty of presenting to the layman that which he accepts as "the last word" until he at least sees the next and similar effort. Without detracting therefore in any way from the beauty of the "ensemble" at the Pan-American, it is to be fervently regretted that the color scheme so loudly heralded as the great and original feature of the show should have proved itself so thoroughly unsuccessful. Comparison with Chicago is in itself hardly fair to the smaller exposition, but we did look for a continuity of design and color which would surpass the White City. Opinion is unanimous, both among the professional and lay public, that the illuminations far surpass any previous effort in artistic lighting and one unconsciously feels that Mr. Ruskin's description of St. Marks as "the loveliest dream that ever filled the human imagination," could with equal truth be applied to the "City of Light."

Strange to say the lack of homogeneity both in color and design so noticeable in the sunlight, is due mainly to the two prime movers in the effort for this very effect. The color far from being brilliant is in many cases muddy and unsatisfactory, while a number of the important architectural features are so thoroughly out of scale that even the beautiful electric tower loses some of its value and fails to show its enormous height. The plan also is crowded with pazolas and other minor features to such an extent that many of the finest vistas are absolutely destroyed, and which even makes it impossible to obtain a satisfactory photograph of many of the important buildings.

One of the pleasing features of the Exposition is the Government Building which compares most favorably with any other work upon the grounds, is thoroughly Spanish in feeling, and is a great credit to the Supervising Architect's office.

IN AN article under the caption, "The Profession of Architecture," in the September *Munsey's*, Mr. J. P. Coughlan makes statements in regard to the conduct of competitions which are considerably wide

## REGISTRATION BUREAU FOR DRAUGHTSMEN.

This bureau is established for the use of architects wanting draughtsmen and draughtsmen wanting positions, free of expense to either party.

All draughtsmen wishing positions may register by answering the following questions:

Name and address?

Married or single?

What experience have you had?

Name and address of last employer?

Salary expected?

References?

All architects wishing draughtsmen are invited to use this bureau.



of the mark, and which are apt to be misleading to the layman who is unfamiliar with the average architect's career. The statement that competitions are usually limited to "two or three invited competitors," and that these competitors are usually selected from the lists of members of the Institute of Architects or the Architectural League, the profession knows to be absolutely unreliable. As the article in question appealed mainly to the lay-public, the profession cannot but regret that Mr. Coughlan did not make use of his opportunities to point out the many abuses with which most competitions are surrounded, and to enlighten the public more fully as to the evils from which the profession suffer on account of these abuses. Most of these abuses, with which we are all familiar, are due to the public ignorance of the architect's work.



PAINT, which like charity, "covers a multitude of sins," has always been a source of great annoyance to the architect. There are few materials with which the superintendent has to deal—which requires so much special knowledge in order to get satisfactory results—and few of which the average architect knows so little. Our only faith has been to insist upon the goods being delivered in the "original packages," and to trust mainly to the reputation of the manufacturer. And even with this precaution as most pigments appear the same immediately after application, we have all been frequently deceived by unscrupulous workmen. We are therefore glad to see that the National Association of Master House Painters and Decorators of the United States have recently appointed a committee to formulate a set of uniform specifications for distribution among the architects, and by means of

which we may be able to accurately describe the various classes of work. It is proposed to draw these specifications in such a manner that we shall be able to specify grades of work, and at the same time avoid calling for special makes of material. With our rather meagre knowledge of the subject we ourselves fail to see just how this can be accomplished—but we have faith in the Master Painters.

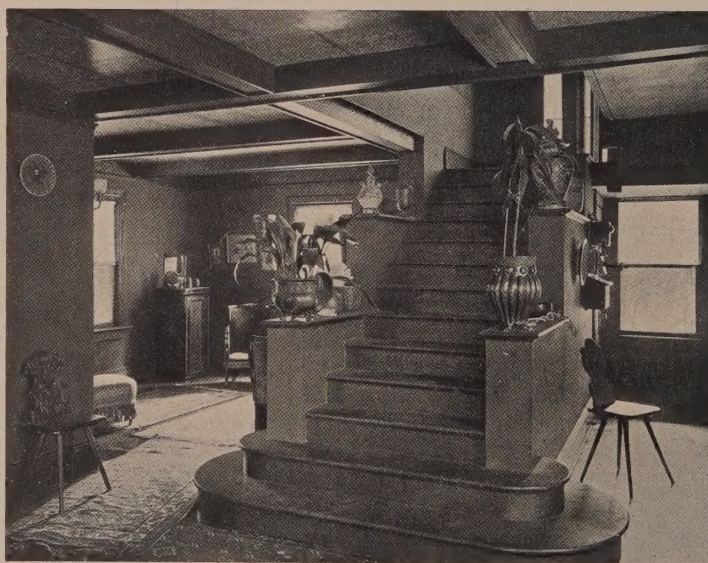


One of the most confusing items in superintendence of painting frequently comes upon the structural steel. The New York Code calls for two coats and three are frequently specified. We know of several jobs now under way in this city where the various coats are specified, each of a different color. In this way a superintendent may at least feel sure of the number of coats the work has received, even if deceived in his material.



THE United States Commission of the International Exposition of Modern Decorative Art of which General L. P. DiCes-nola is President, and which is to be held in Turin, Italy, in 1902—has recently issued a circular to architects, decorators, sculptors and other eligible exhibitors, stating the scope and plan of the exposition and inviting contributions. A second circular giving a more detailed description of the scope of the exposition was

issued in the latter part of August, and special prizes are to be awarded for the following subjects: 1. For the best decorative scheme for an elegant suite composed of at least three rooms. 2. For a similarly decorative scheme treated economically. 3. For the best decorative scheme for a sumptuous room. 4. For the best decorative scheme for an economically decorated room.



ENTRANCE HALL AND LOGGIA, RESIDENCE, EVARTS TRACY, PLAINFIELD, N. J.  
Wurts, Photo. Evarts Tracy, Architect.



THE coming convention of the American Institute of Architects will be held in Buffalo, N. Y., October 3 to 5, inclusive. After the address by the President, Mr. Robert S. Peabody, the reports of the Board of Directors, Chapters, Standing and Special Committees, and the report of the Chairman of the Committee on Government Architecture, Mr. Geo. B. Post, there will follow papers on the effectiveness and possible improvements in the Tarsney Act, by Mr. Cass Gilbert, of St. Paul, Minn.; Mr. W. A. Boring, of New York; Mr. John H. Rankin, of Philadelphia. In connection with actual study of the buildings, decoration, statuary, landscapé, and their grouping in the Pan-American Exposition, the following papers have been promised: Mr. Carlton Sprague, of Buffalo, on Some Phases of Exposition Making; Mr. W. D. Kimball, of Omaha, Nebraska, on The Management and Design of Expositions; Mr. C. Y. Turner, of New York, on the Exterior Color Effects; Mr. Luther Stieringer, Electrical Installation and Decorative Effects in Pan-American Exposition.

A FRESH chapter in the history of the Pennsylvania State Capital has been opened by the dismissal of the architect, to make room for a new one, to be appointed by the commissioners. Henry Ives Cobb, who was selected by the commissioners after the first competition had been set aside, and who prepared plans which have been in part carried out, claims that he was definitely employed to complete the work at the usual compensation, and proposes to enforce his rights in the courts, while the commissioners maintain that he was only employed to furnish designs, and that he has been paid for these, and has no right to further employment.

THE act to license architects in California went into effect on August 23d, and after that date anyone practising in that State without being registered is liable to a fine of from \$50 to \$500 in

the discretion of the magistrate. If this matter is to be pushed again in New York during the coming session of the Legislature, it will be well for the committee in charge to study the California act.

#### WASHINGTON HOSPITAL COMPETITION.

THE following letter was sent the Commissioners of the District of Columbia, Washington, D. C., by the Washington Chapter, A. I. A., and the Washington Architectural Club, as a protest against the unreasonable requirements in the Washington Hospital competition:

GENTLEMEN:

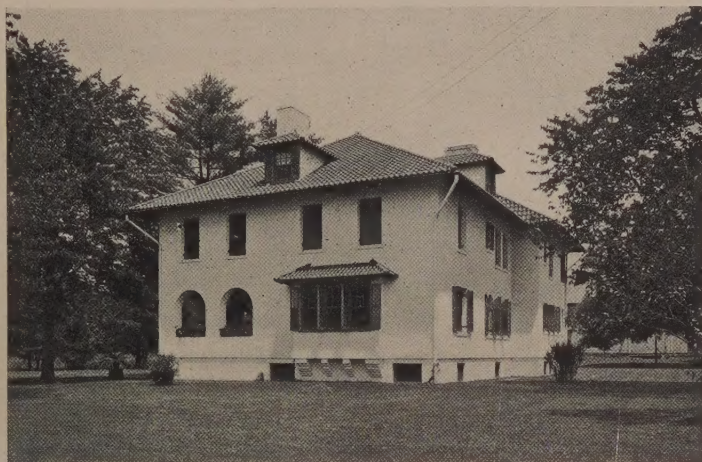
The Washington Chapter of the American Institute of Architects desires to ask your attention to certain terms and requirements in the program of competition recently issued to architects for the proposed Municipal Hospital for the District.

Material points of difference exist between the program and what we believe to be vitally essential to procuring a design for the proposed structures that will prove satisfactory and acceptable to your honorable body and to the community.

The program demands of each competitor the preparation of about thirty sheets of drawings of one-eighth inch scale, practically constituting a set of working drawings. No set of plans, however meritorious, is assured of selection. Should any set be selected, the compensation in full that is definitely authorized is \$3,000.00, an amount less than usual in value when computed and charged for in accordance with generally accepted rules of practice, as applied to works of such importance, magnitude and cost. The time fixed for

the completion and delivery of the drawings is limited to the too brief period of about seven weeks from date of issuance of program.

We submit that better and more satisfactory results in the competition may be obtained by requiring as few drawings as possible to illustrate the proposed scheme and these to be of a more diminished scale than the program calls for. By this means each competing architect is enabled to devote his skill and energies to a proper solution of the problem as a whole and is not burdened with the heavy expense and time in the laborious production of numerous and elaborate drawings. Such drawings of a diminished scale, designated as preliminary sketches, offer the further and most important advantage of ready comparison and decision of merits by the jury of award. These limited require-

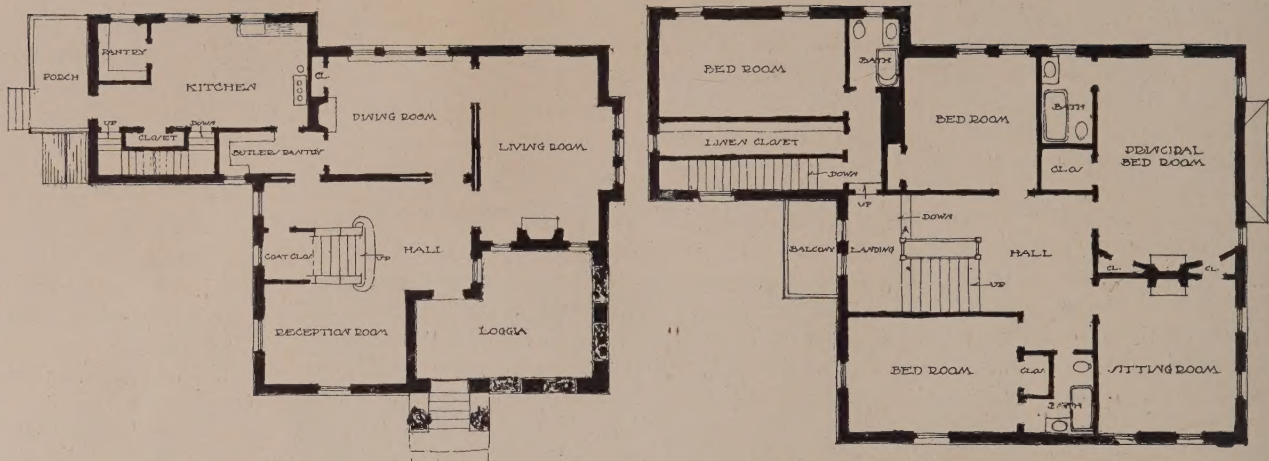


EXTERIOR VIEWS, RESIDENCE, EVARTS TRACY, PLAINFIELD, N. J.

Wurts, Photo.

Evarts Tracy, Architect.





FIRST AND SECOND STORY PLANS, RESIDENCE, EVARTS TRACY, PLAINFIELD, N. J. Evarts Tracy, Architect.

ments prevail in the government architectural competitions under the Treasury Department, and have been productive of the most desirable results.

FREDERIC B. PYLE,  
*Secretary Washington Chapter A. I. A.*  
 WADDY B. WOOD,  
*Chairman Com. Wash. Arch. Club.*

### THE MODERN APARTMENT HOTEL.

THE modern apartment hotel has for one of its features a complete telephone system, with an exchange of its own. Every tenant has a telephone in his own apartment, with local and long distance connection. He can have his telephone beside his bed so that he can call anybody, anywhere, without arising if he so desires.

But it is for communication within the house that this telephone system is brought into the most common and constant use. It is not necessary to send a boy up to the apartment to ascertain if a person whom a visitor desires to see is in. They simply telephone from the office to the apartment in one-tenth the time required for a boy to get the information. The tenant has a perfect means of communication with the office without leaving his apartment.

The manager, or superintendent, has communication from his office with the chef, the engineer and the house-keeper so that he can speak with any member of the house staff, or they may speak to him, without the running to and fro or a loss of time.

Such an installation costs considerable, but on the other hand a house so equipped will need the service of only half the usual number of hall boys.

A newer wrinkle is providing a safe deposit box for each tenant. A section of the big house safe is divided into separate small locked compartments set apart for the use of tenants.

Though the apartments may not be used for house-keeping, yet the modern building of this class has a refrigerator in every apartment for wine, fruit, etc. In some buildings no ice is used in these which are cold storage rooms in miniature, kept cold by means of a refrigerating plant installed in the basement with a system

of piping extending to every refrigerator box. In some buildings the ice refrigerators are preferred, these of course being specially designed.

In one house there have been built refrigerators designed to hold an ice block of specified size, the ice being supplied by the house. At fixed intervals according to the weather, the house removes whatever ice may be remaining in the ice compartment and puts in a new block. In the latest modern apartment hotels, in apartments not designed for house-keeping, which may be had in any number of rooms from two up, a refrigerator and bath room would be found in a two-room apartment as in any other.

### THE ARCHITECT'S SENSE OF COLOR.

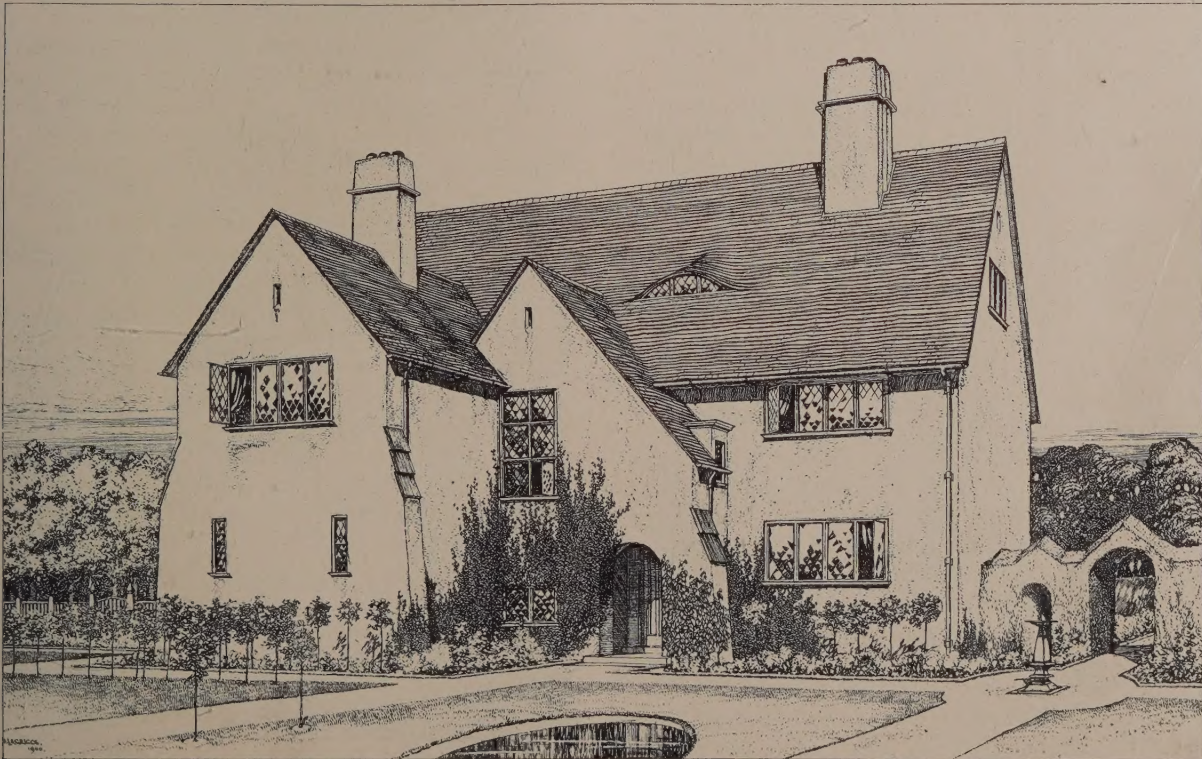
TREATISES and papers dealing with color for architectural use have appeared in abundance; lectures on color and decoration have been given by artists and architects, yet their teachings have done very little towards improving the sense of color harmony in our buildings, says the *London Building News*. Why is this? Is it not because the subject has been too much considered from a decorator's point of view, who looks upon color as so much flat paint of such and such a tone at so much per yard?—or proposes a "scheme of decoration" according to his notions that may be simply crude and execrable except in one particular situation and in a certain light. Light has to do so much with color effects, that no scheme can be laid down with any degree of success unless its effects in softening and subduing tints are properly considered. We are naturally disheartened when we contrast the beautiful harmonies of color seen in many a Mediæval cathedral or church with those of several of our modern church windows—those, for example, of Chartres, Notre Dame, Paris, or many of the examples in our own old churches, with the crude, garish introductions of the Revival period, which still offend by their crude blues and violets, greens and reds. Have we lost our color sense? Mr. A. Wallace Rimington, R. P. E., Hon. A. S. A., in his paper on "Color in Architecture through an Artist's Glasses," is inclined to think we



have. He speaks of the early "frescoes in French and Italian churches which show a widespread feeling for good color," quite absent in those of the present day, and "that in out-of-the-way and little-modernized parts of Europe a pronounced color sense still lingers amongst the people," implying that in the more modern parts the sense has decayed or has deteriorated. Is it not possible that our artificial tastes and habits have been the cause of this decline of one sense? We fear there is some truth in the allegation. Mr. Rimington's remarks disabuse our minds of much of our ordinary ideas of color in architecture. As he asserts, most people have their opinion about harmonies of color, which are, we know, widely different. Color is certainly more difficult than musical sounds, as the color scale depends on a range of ether waves more subtle than those of audible vibration. As Mr. Rimington observes, "the colorist has to stop his intervals upon a string a hundred times as long as that of the violinist, and he has often to strike a chord of color with many more notes in it than a musical one, though if he be a great colorist he will produce it with unerring feeling and truth. Every good picture is, in fact, a series of such chords, carefully selected and combined; and perhaps we may venture to assert that every building ought also to be, even though its color harmonies may be simpler."

We have spoken of the imperfect ideas many decorators have of color;—they seem to think of nothing but flat coats of paint. But if we take nature as our guide, we find that there is no such thing as evenness of color: every leaf and flower shows varying degrees of tinting or tone intensity, the color is full of gradation; and the

first principle of color Mr. Rimington lays down is that the strongest or richest color is in the half-tones. This is explainable by the fact that "the power of any color-producing surface to absorb the vibrations which it abstracts from white light is limited. Thus when light falls most strongly upon an object, there its color-producing powers will, after a certain degree of illumination, be most weakened;" but when the light is less strong there will be less dilution and richer color, so that according to this natural law, the painter should not put his strongest color into the high lights, but upon the half-tones, and in like manner the architect should not place his weaker color below the eaves or cornice, "or into any under-cut portion of a projecting moulding or into any hollowed or shadowed surfaces, but rather into those exposed to the full strength of the light; conversely, if it were desired to strengthen the general color effect it would be well to enrich the former (that is, the recessed part) with relatively strong and warm color." One is often struck, he says, "by the way in which a building of warm-toned material has been made unbearable to the artist by the shivering coldness of its painted woodwork, just where the eye, accustomed to Nature's methods, would expect additional warmth and richness," and he instances the brick and terracotta architecture of Italy, where the recessed mouldings are kept warm and full in color, as in Pavia. Cool colored materials are avoided in the shadowed parts. According to this rule, the white painted window-frames and sashes and other woodwork in recessed parts are wrong, and the stuccoed coves under the eaves of red brick buildings are contrary to natural harmony, doctrines which will conflict with the practice of "Queen



DESIGN FOR A COUNTRY HOUSE. Niven & Wigglesworth, Architects.





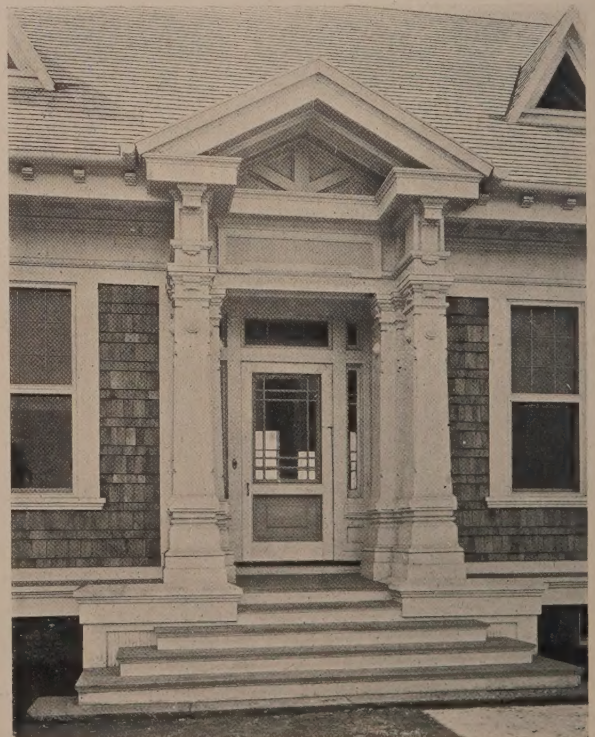
CHILDREN'S HOSPITAL, ST. JOHN'S GUILD, NEW DORP, STATEN ISLAND.  
Walker & Morris, Architects.

Anne" architects, and indeed with the ordinary building, where the mullions and mouldings of windows and doorways are generally in cool colors, but according to the same principle it is wrong to put the richest color in the "high lights" of a building, such as cornices and projecting members. The principle is also logical if we consider that if we put the richest color upon the salient features like cornices, and the coolest on the recessed parts of openings, we are contravening the architectural meaning by lessening the effect of the architect's intention as regards light and shade. Color thus employed contradicts the meaning of form. There is one argument, however, that might be used in favor of the plan of placing the lighter, less strong colors in the recesses and frames of windows;—and that is that it reflects light, whereas the darker colors would absorb it. The author of the paper refers to several Italian examples, where the warm and rich colors are introduced in the shadowed mouldings.

The principles of "inter-contrast" and "quality," or texture, are neglected by architects; the first of these is defined as "that interweaving of divergent colors which tend to make them appear pure and luminous." Every great landscape painter has shown us the value of this quality in the luminous effect of his skies, and distance and foregrounds. The sea-scapist loves to give this "vibratory" sense of color to his seas, breaking them up into tints of violet, blue, red or green. Both know how extremely unlike the natural sky or sea is an absolutely flat color of the same tint throughout; there is no vibration or luminous effect in such flat uniform washes, and we recognize that there is a physical reason for the value of broken color—namely, that the retina is stimulated by the juxtaposition of slight complementary colors in small quantities. It is called the art principle of "exchange" or color balance, and is "essential to give color its full power and interest," as Mr. Rimington says. The architect cannot neglect this principle; we have lately spoken of the dull monotony of a uniform color in a brick wall or a tiled roof—how dead and uninteresting they are; yet we find numerous modern red brick and tile or slated buildings that are of this kind. No painter would care to paint them. It is because they lack the

"inter-contrast" and vibratory quality of color harmony that they are so cold and crude in color, so offensive to the artist's eye. By not insisting on bricks and tiles of uniform color and texture, and by specifying them to be selected with a regard to the varied tints produced by the "firing" we may avoid this harshness. Machine-made bricks and tiles are for this reason not so pleasing as hand-made; rough surfaces, too, are broken and reflect light and produce the desired interminglement of color. We have so lately spoken of the value of "texture" in architecture, of the artistic charm of rough, hand-made surfaces, tooled stonework, and hammered iron, that it is hardly necessary to say more on this point.

What the author of the paper calls "exchange" or partial repetition, is really an extension of the same principle, and is the carrying over of a small portion, or repeat of one color mass into another. In nature the blue of the sky is carried down in cool shadows or reflections into the warm tints of the landscape; the red sunset is repeated in the cool shades of the foreground or foliage; and as in nature so in architecture we learn a lesson of repeating in small portions, as in bands and panels, and even in dots of colored material, the prevailing mass of color of some other part. St. Mark's, Venice, exhibits this principle of "exchange." In many other Venetian buildings we find this repeating of the warmer colors in masses of the cooler, and every decorative artist understands the value of bringing the color say of colored marble columns or some prevailing material down into small panels in bands or pilasters. The idea of color repeats



ENTRANCE CHILDREN'S HOSPITAL, NEW DORP.  
Walker & Morris, Architects.



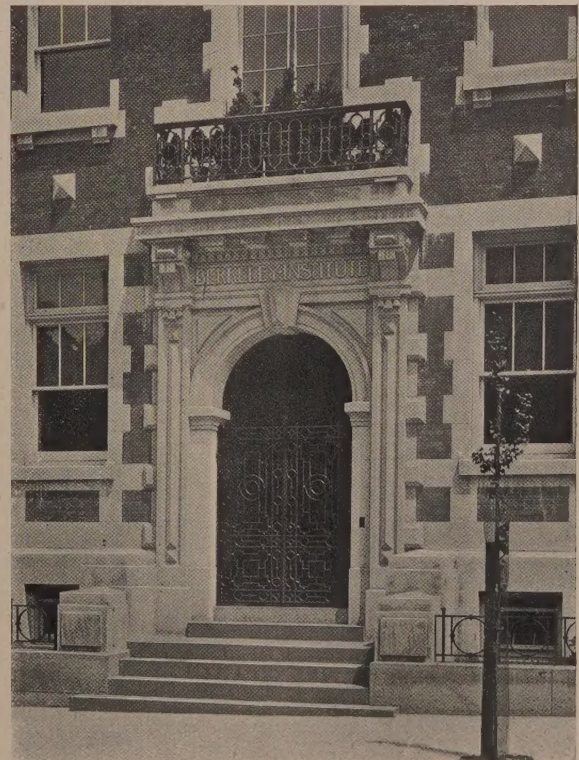


BERKELEY INSTITUTE, BROOKLYN. Walker & Morris, Architects.

is used by decorative artists in color schemes, but often in an unmeaning manner;—not by exchanging the warm with the cool and grey tones, but in the contrary manner, so losing the sense of unity. Thus we have seen the reds repeated in the warm colors, and blues in the grey tones; or the warm colors of the entablature and frieze not brought down into the wall panels and pilasters of cooler tones as they should be. With the principles of gradation and contrast, the architect is more conversant, though we seldom see gradation of form or color carried out in a pleasing manner. In color, indeed, the architect has less opportunity, as he does not often deal in colored marble; but the same principle can be applied in using warm and grey or cool colored stones together. If there is grey granite, this may go into the basement or piers, and the lighter sandstones lead upwards in the order of their delicacy or richness. Mr. Rimington referred to the Palazzo Publico of Piacenza. The substructure of the north facade is “of pointed arches raised upon piers of cool-toned marble, but intermingled with stone of a warm tone, which approaches a delicate pink-grey of indescribable tint at the upper part of the arch and in the spandrels.” The first story is built of red terracotta, and the grey of the substructure is “exchanged” into this in small quantity by the marble shafts of the windows, and the color tends towards increased warmth or richness in the battlements, which are red brick of the deepest burnt sienna, mellowed by age, but still forming “a splendid ‘trumpet-blast’ of red against the sky.” There can be no doubt that more buildings are “ruined by overcontrast than from any other cause.” Contrast is a powerful instrument, to be used with discretion, or harmony is destroyed. In the hands of the vulgar it is resorted to with delight, in architectural decoration it is often blatant and

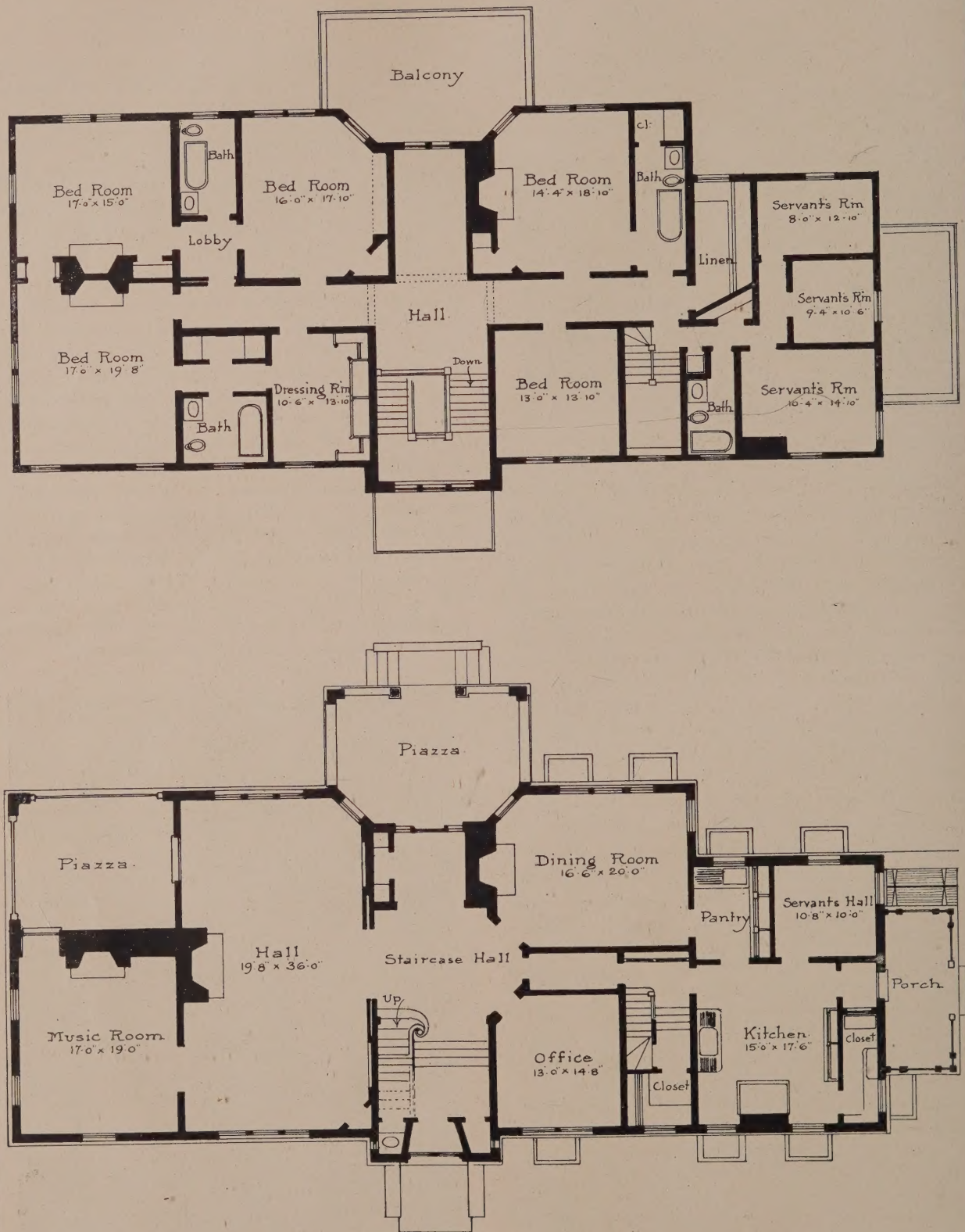
intolerable in its harshness, and in many buildings the strong contrasts have indeed done their “vulgarest worst” to shout down the street advertisement. But contrast is a quality that should be only used when gradation can be maintained in the main parts of a scheme; when used frequently or strongly, it destroys the whole unity and harmony of the work. Other principles, such as breadth and harmony, are equally important in color studies, but these are better known.

Mr. Rimington’s interesting paper will be helpful if it makes the architect think more seriously of his color schemes; that they do not depend for their harmony on mere lucky assortments of color, but upon well understood physical facts; that in all pleasing color arrangements there are underlying physical laws as certain and exact in their operation, as those which underlie the science of musical harmony. One of the first things he has to learn is that Nature’s scheme of color, as exhibited in the leaf and many-petalled flower, the color of the sea and the sky, and in every building of stone or brick that has been mellowed and harmonized by age, is not truly represented by so much color of the same tone applied in flat washes, but is full of vibrating light constantly varying in tone and pitch; and that, in fact, no two parts of a flower’s petal are of the same color, and that the strongest and richest color is to be found in those portions where light is less strong. Before he understands this principle of variation of color and gradation, it is impossible for him to arrange any agreeable color scheme.



ENTRANCE, BERKELEY INSTITUTE, BROOKLYN.  
Walker & Morris, Architects.



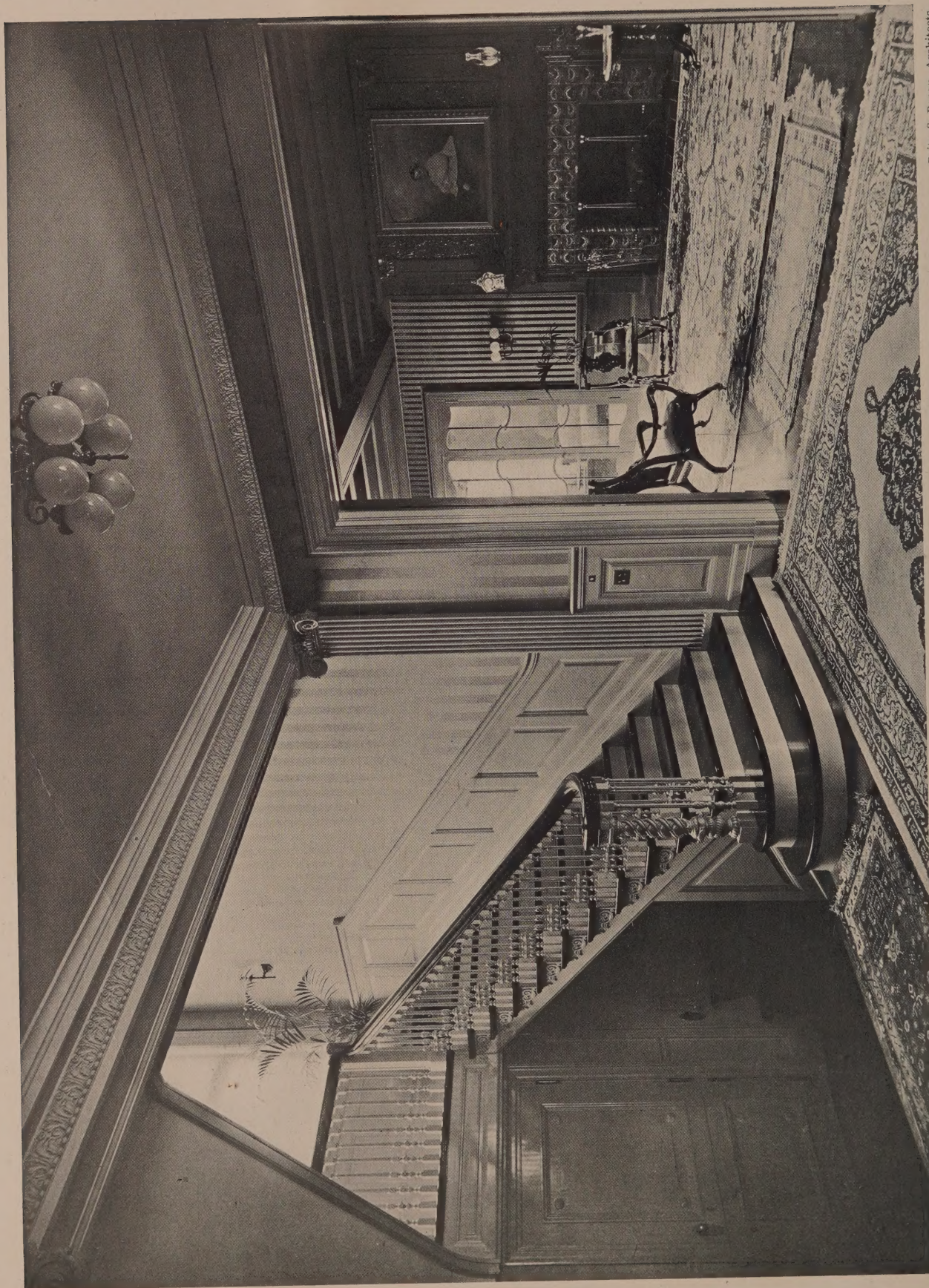


FIRST AND SECOND STORY PLANS, RESIDENCE, H. A. LA FETRA, SUMMIT, N. J. Brite & Bacon, Architects.









Wurts, Photo.

HALL, RESIDENCE, H. A. LAFETRA, SUMMIT, N. J.

Britte &amp; Bacon, Architects.









Wurts, Photo.

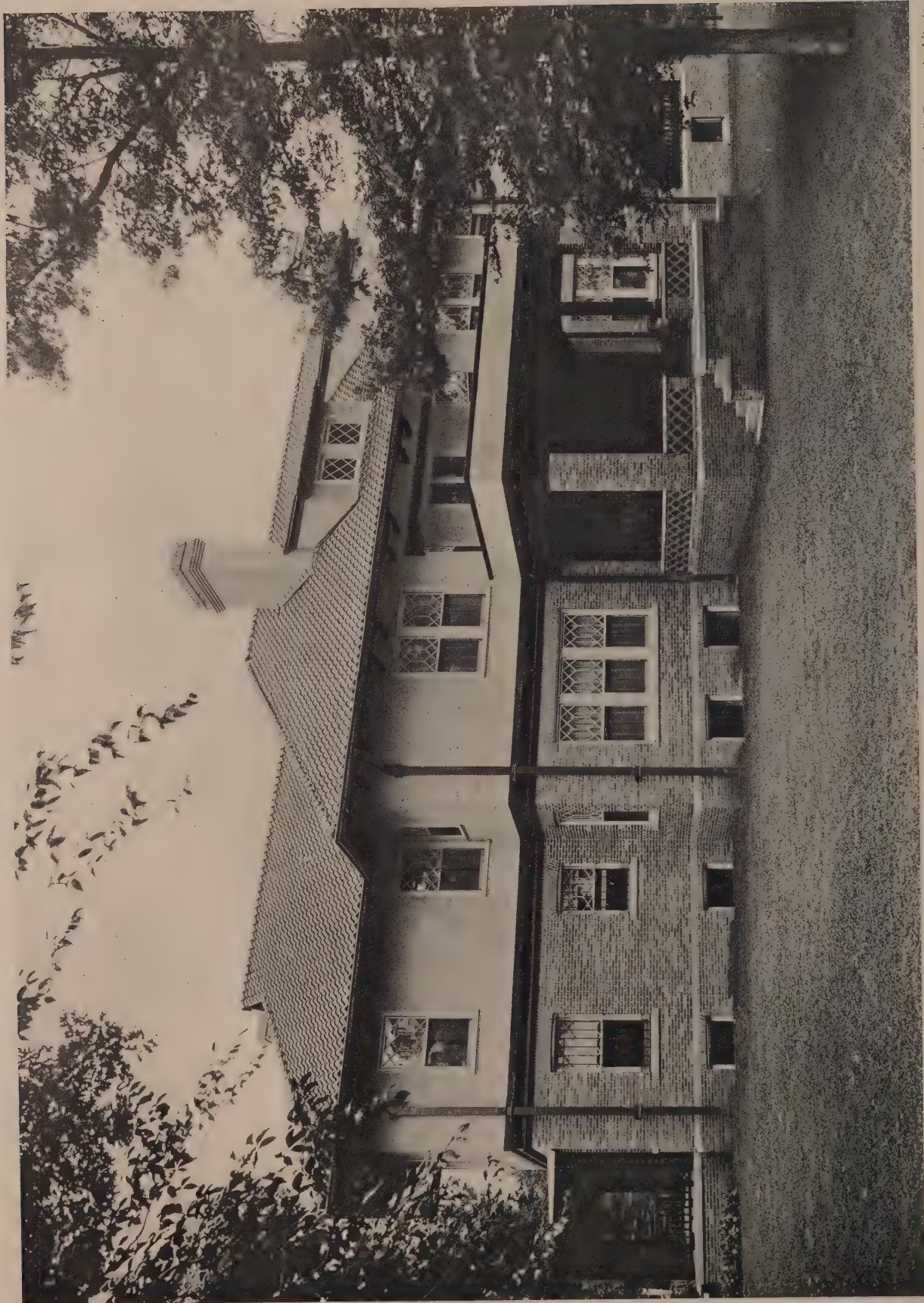
ENTRANCE FRONT, RESIDENCE, H. A. LAFETRA, SUMMIT, N. J.

Brile &amp; Bacon, Architects.









Wurts, Photo.

RESIDENCE, H. A. LAFETRA, SUMMIT, N. J.

Brite &amp; Bacon, Architects.





Brite & Bacon, Architects.

ENTRANCE TO RESIDENCE, H. A. LAFETRA, SUMMIT, N. J.

Wurts, Photo.









RECEPTION ROOM, COLUMBIA YACHT CLUB, EIGHTY-SIXTH ST. AND NORTH RIVER, NEW YORK.

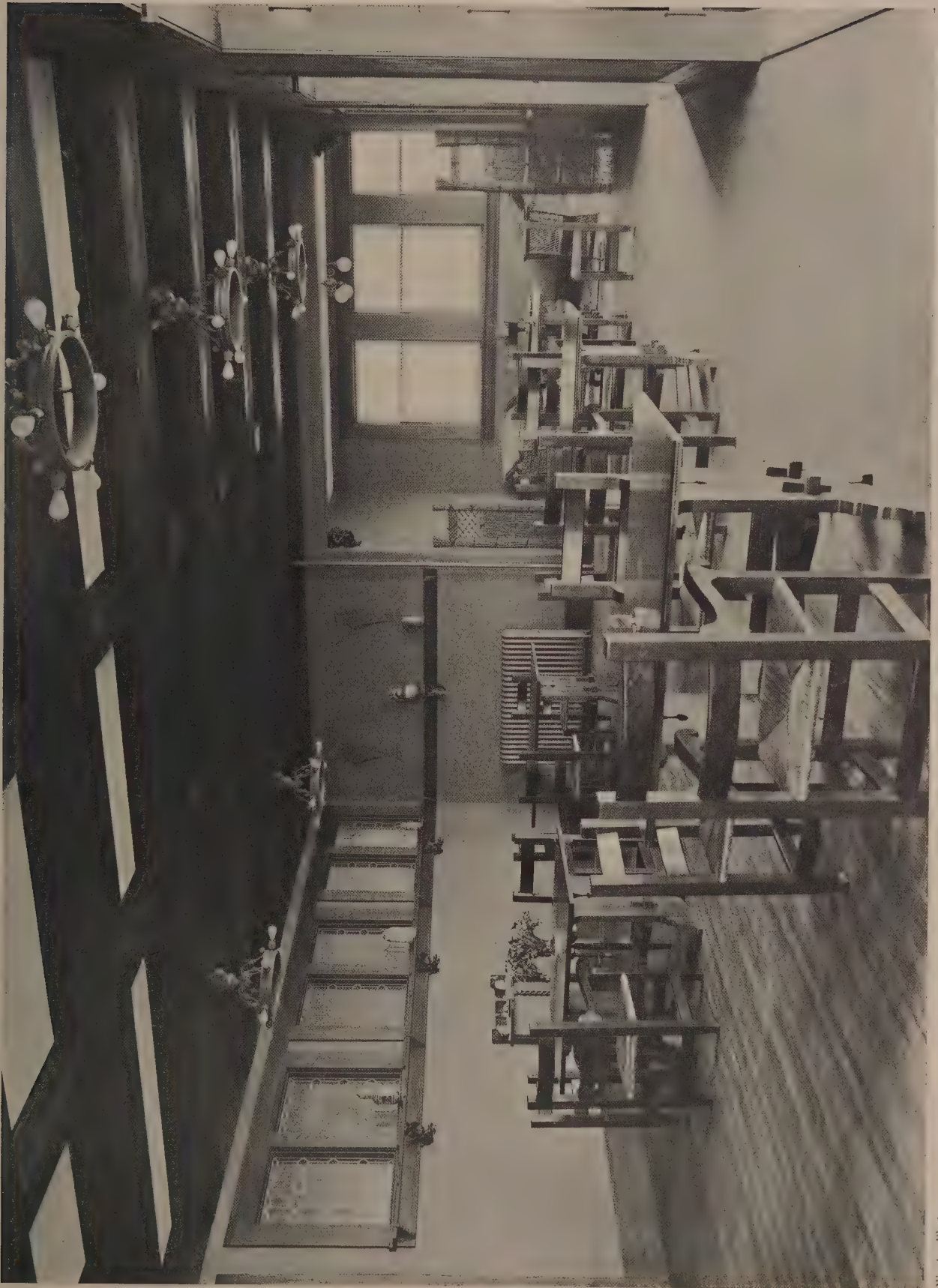
W. B. Tuthill, Architect.

Wurts, Photo









W. B. Tutill, Architect.

GRILL ROOM, COLUMBIA YACHT CLUB, EIGHTY-SIXTH ST. AND NORTH RIVER, NEW YORK.

Wurts, Photo.







## ACOUSTICAL PROPERTIES OF BUILDINGS.

(CONCLUDED.)

Modifications of sound are experienced in most buildings or rooms, these being due to various causes—the shape, the amount of absorbing materials, the disturbing effects of obstacles like arches, timber roofs, galleries. Theoretically, perhaps, the speaking-trumpet form of room is the best for conduction without impeding the force, as this form collects the sound and conveys it forward. Architects sometimes design rooms and theatres on this plan, the walls, ceiling, and floor being made to converge towards the platform or stage; but the shape of such an auditorium would not be pleasing or architectural. Such a shape, however, ought to be present in the architect's mind whenever he is designing a concert room or lecture hall. In other words, he should try and contract the space above and around the lecture rostrum or orchestra as much as possible, so that the initial sound or impulse may go forward as the voice does in a speaking trumpet. The ordinary type of concert hall, with a platform or orchestra inclosed within a recess, or slightly projecting from it, fulfils this condition to some extent, even if the walls beyond are parallel. As we have been speaking chiefly of direct radiation of sound, we may consider for a moment the best plan. If radiation is to govern the form, the elliptical or semicircular shape of the auditorium is the most natural, with seats arranged in circular rows around it, or as in an amphitheatre; but in by far the greater number of buildings the

shape and direction of the walls are rectangular or oblong, and the sound is directed by the walls and ceiling. In other words, the audience hears by conducted radiation, as in long churches and cathedrals. Practically these two conditions are often combined—that is, the audience may hear partly by radiation, partly by conduction, along the walls and ceiling. The lecture theatre, such as we see in connection with many technical and scientific institutions, semicircular in form, represents a building governed by the radiation of sound, but the ordinary oblong lecture and concert halls are governed by the latter principle of conduction, or should be so. In this case the natural sound first radiated is directed between walls and ceiling, and preserved from the lateral escape of the sound, and reinforced by reflection. As most buildings fall under this class, we may give them our chief consideration.

Regarding the principles we have enunciated, the walls of a lecture or concert room or church should be as straight and uninterrupted as possible; therefore an oblong room with its corners rounded or canted, and a ceiling also of the coved or elliptical form ought to be the more favorable than one broken by recesses to transcepts which allow the sound-waves or escape. Such a conclusion is founded on the principle of the propagation of sound in a tube of any length, and the undulations of air caused by compressions and dilations in it. There is no way of escape, and the undulations or waves are carried onward. The effect of obstruction to the passage



DESIGN FOR A COUNTRY HOUSE. Niven &amp; Wigglesworth, Architects.





DESIGN FOR ONE DOUBLE AND ONE SINGLE HOUSE AT NORTHWOOD. Frank W. Elgood, Architect.

of sound must be considered, and generally it may be said that whatever obstructs the line of vision or sight will obstruct sound, though to a less degree. An obstacle like any projection of a building, a deep internal pier, or the pillars of an arcade in a church will interrupt the waves of sound and cause their partial reflection. Galleries are necessary in large town halls, but are often obstacles to the conveyance of sound to those below, and side galleries of great projection are the worst in this respect. An end gallery is less objectionable, and may even prevent an echo in some rooms used for music or speaking. The effect of deep side galleries upon the audience is rather to increase the volume of sound above them owing to their raking seats, and to cause the people in the galleries to hear, as sound generally ascends, while just the opposite effect is observed by those below the galleries, owing to the breaking up of the sound waves, the main undulations passing over the gallery. Projections at right angles to the walls in the direction of the sound cause eddies of sound to form, just as may be observed along a river current by a succession of headlands making coves in the banks or cliffs. These eddies of sound produced by reflection have the effect of interrupting and disturbing the main body or undulations, and thereby of deadening the sound or causing echo. Transepts also impede the propagation of the sound by allowing it to spread laterally, and, therefore, they are as a rule unfavorable to hearing a preacher, where, as usual, the pulpit is placed at one of the angles eastward of the transept. We have already noticed the advantages gained by an uninterrupted sight of the speaker and the adoption of the "isacoustic" curve in the seating arrangements. Absorption is a still more important property to consider, but one that is generally neglected by the architect and fitter of our large halls and theatres, and upon

this subject a great deal may be said. Sound is absorbed by large spaces near the speaker or singer, as well as by soft surfaces, such as carpets, curtains, wall hangings, cushions, and drapery of all kinds, and mainly by the audience itself;—all of these absorb or deaden sound. A great deal of this absorbing property may be avoided by the architect in his adoption of certain wall and ceiling material—a great deal also must be allowed for. The presence of an audience, as we all know, considerably deadens the effect of music or singing; the clothing of men and women presents a large amount of absorbing material, and as this is beyond control of the architect, he should make allowance for it by the use of reflecting or resonant material; just as when there is too much reverberation, echo, or resonance, hangings and drapery are of value in reducing it. Sometimes the effect of carpeting or matting, or of placing curtains up just on those parts of the building where echoes are produced will have a wonderful effect. Generally, however, the presence of a large audience will so considerably deaden the voice or the resonance that the aim should be to lessen the quantity of carpets, drapery, and cushions in rooms intended for speaking. The problem of architectural acoustics is mainly that of counteracting one property, as that of resonance or reverberation, by another. Every change from a normal standard or model must be compensated by some other;—a change in material by a change in the size or distribution of the audience; a change in size by a change in the proportions or shape. So the absorbing power of furniture and walls in different buildings should be ascertained, and the quantity in any given successful room for sound be made a determining factor. The property of absorption may be regarded, in fact, as the opposite to reverberation.



eration, and the architect must find the corrective to an excess of one in the other property.

Reverberation which may amount to an echo is another of those properties which disturb and confuse the clear delivery of sound. A badly shaped or proportioned room is one of the causes of reverberation; lofty ceilings, plain unbroken walls, large lantern lights, are often productive of this disturbing noise. We all know the unpleasant reverberation of sound in large empty houses or rooms, the correctives of which are the carpets and furniture. Numerous causes contribute to this impediment, as smooth plastered surfaces in which cement is used, damp walls, large empty spaces under the ceiling, vaults and coffer, recesses and niches, deep reveals to openings, which afford spaces for the air, give rise to vibrations under the exciting cause of the undulations of sound, and cause confused noise or reverberation. In a word, large flat surfaces, square corners, and recesses should be avoided or draped over in rooms subject to reverberation of an objectionable kind. Echo is an intensified reflection of sound caused by a reflecting surface or wall at some distance from the source of sound. The reflected sound thus produced is an echo, if it occurs at some interval after the original sound, for if the reflecting surface is near the speaker the sound and the reflection will be nearly coincident, and no distinct repetition of sound will take place. End walls of long rooms, high ceilings, and surfaces at some distance from the platform or orchestra may form reflecting surfaces. These disturbing sounds are often broken or lessened by projecting features, like gallery fronts, columns, drapery by which the

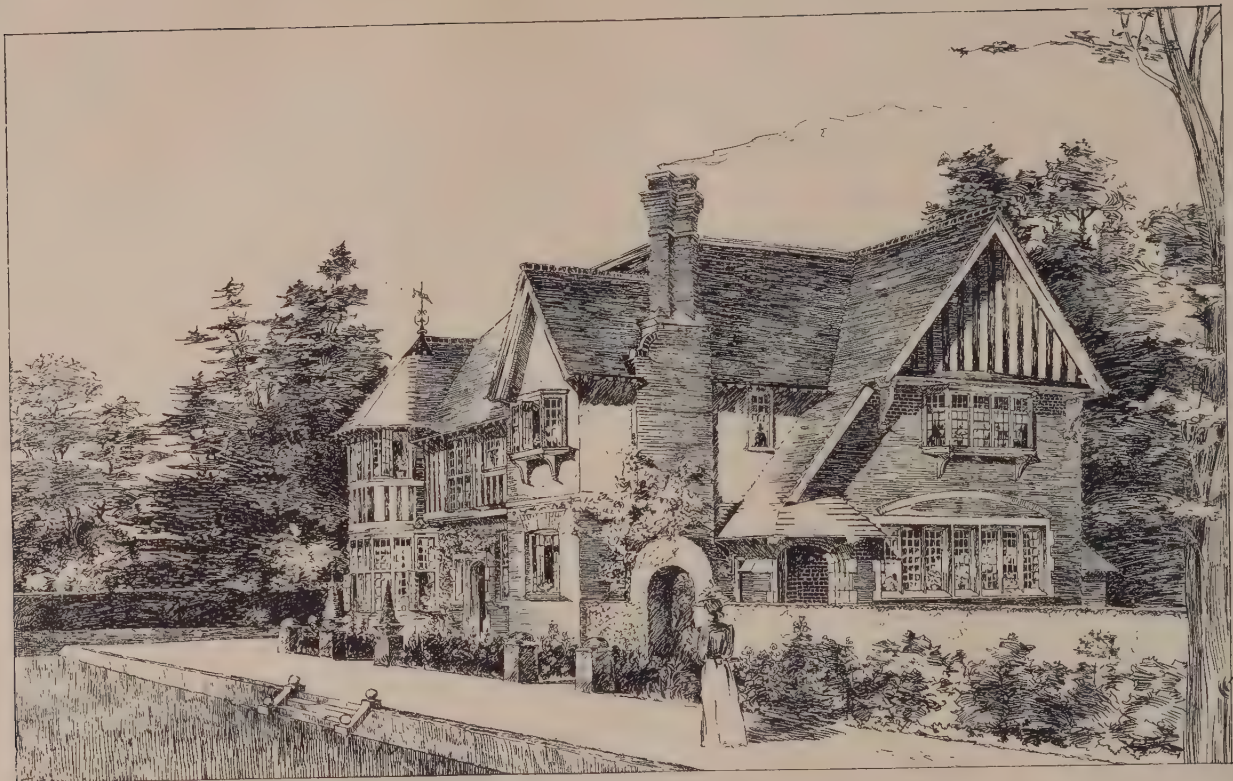
directness of the sound is broken or deadened. In many large rectangular rooms with flat ceilings, the best remedy is to form coves between the walls and ceiling to cut off the further angles of the room by partitions or hangings.

The aim of the architect should be to eliminate as far as he can the disturbing agencies we have described in the planning and the fittings of his building. His compliance with certain theoretical conditions will not be satisfactory. For example, he may adopt a form of room the least adapted to secure the conduction of sound by radiation, and yet find that the sound is disturbed by reverberation or echo; or he may have taken care to avoid all unpleasant reflecting surfaces, and find that the speaker or singer is very badly heard at the distant end of the room—in fact, the sound requires reinforcing. By preserving the undulations of sound from dispersion or escape, he may be exactly doing the thing most favorable for reflection and echo, so that, in fact, what we attain by one rule we lose in some other property, equally important for the satisfactory transmission of sound. Indeed, the subject of acoustics is too subtle to be considered on any hard-and-fast lines. One property can only be attained by considerably weakening or destroying another, so that the only course to pursue is to deal with each tentatively, and to give to each room its due proportion of the properties it ought to have, based on experimental observation of the best models. It will be found, in short, that a certain proportion of room being determined, and its dimensions fixed, that its contents and materials exercise a more decided influence on its acoustic effectiveness than its



DESIGN FOR HOUSE AND GARDEN. Mallows & Grocock, Architects.





DESIGN FOR A COUNTRY HOUSE.

Brown &amp; Barrow, Architects.

precise form; and this procedure is that which nearly accords with the practice of the architect. A certain length, width and height of room are fixed in most cases by the site and plan; and this proportion has to be made effective for hearing by subsidiary means—like furniture and arrangement of seats, and the choice of proper materials to obtain a due degree of resonance. In buildings such as theatres, concert and lecture-halls, where we are free to adopt any form we like, the case may be different: we can adopt a proportion, dimensions, and section that have been known to give good acoustical results; but we are not now considering such a condition.

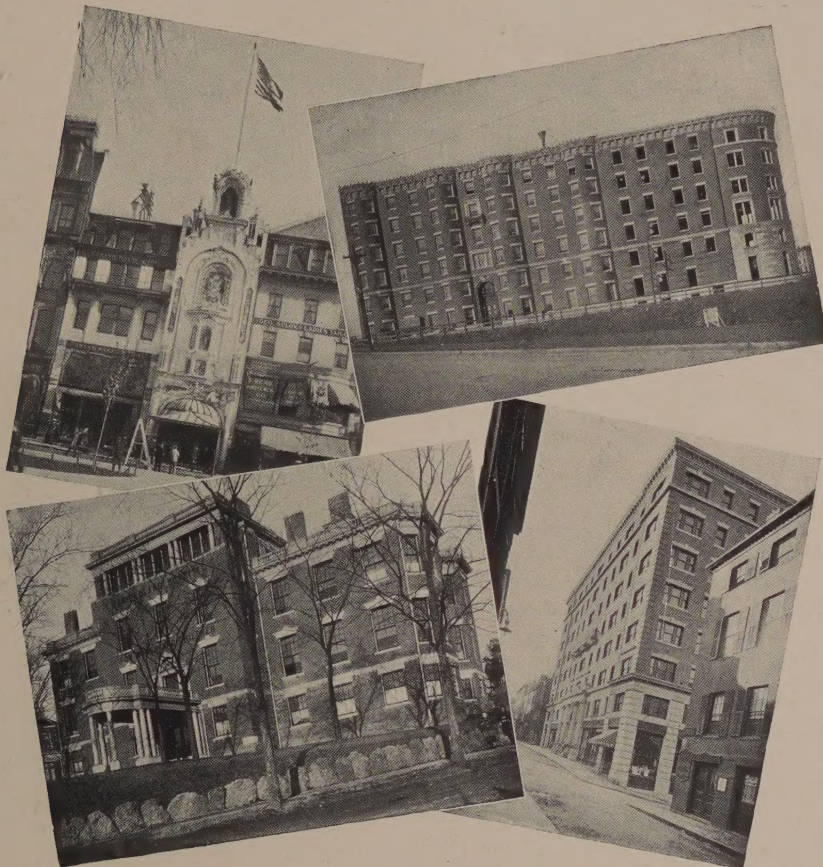
We may therefore devote our remaining observations to these subordinate, less palpable though more subtle, properties which produce resonance, reverberation, or echo. And as to the first of these, a great deal must be learned experimentally. Every room has its own "note," or sympathetic vibration. Resonance may be described as a property which intensifies and prolongs sound, and this is largely resident in the materials of the building, the walls, and its fittings and furniture, as well as the volume of air inclosed. It may be excessive and confusing, amounting to a cost of reverberation. As we have referred to the speaking trumpet as illustrating the best form for conduction or transmission of sound by radiation and reflection, so the violin illustrates by analogy the property of resonance. It has been shown that every part of a violin contributes to the result, and that no portion can be altered without deteriorating the quality of the sound. The included volume of air in the body of the instrument dominates and harmonizes

the whole. The resonance of the upper and lower plates, for instance, is the result of the vibration of the mass of air, in unison with the note of the string; in short, the wood reciprocates the note. As the violin is in unison with the note of the strings and reciprocates their sound, so every apartment has a note of its own due to the materials of its walls and fittings. There is the resonance due to the materials, and that due to the volume of air the room contains. Experiment has demonstrated certain facts which show the value of resonance in aiding the sound. If we place some sounding body such as a tuning fork in the mouthpiece of a speaking trumpet or parabolic reflector, the sound will be conveyed to a distance, and be louder in one direction only—that, in fact, in the direction of the trumpet or reflected sound. On the contrary, if it is placed in contact with a violin or some resonant body of wood, the sound will appear not only louder, but be diffused in every direction; it will also be found to be more distinct, and more musical in quality. Every resonant body of air has its peculiar note, and its sympathetic vibrations afford support to that note or its harmonics—a fact that can be demonstrated by experimentally placing tuning-forks near the mouth of an organ-pipe voiced to a certain note: the fork that has the same note or its octave, will emit a more intensified sound owing to the sympathetic vibration of the air in the tube. These and similar experiments prove that the resonance of materials like wood, combined with the body of air we obtain in a room, may possess a distinct value in strengthening and enriching the quality of sound. The mass of air independent of other substances with which it is not in



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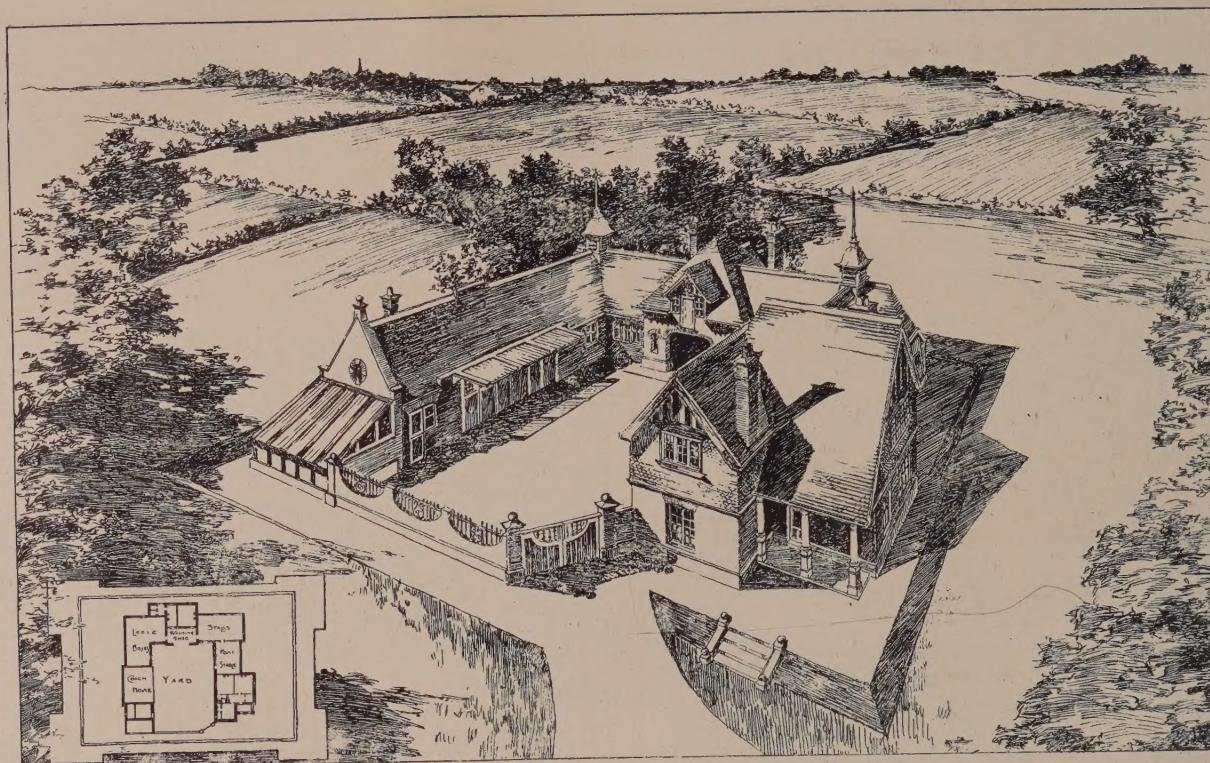
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DESIGN FOR A STABLE. Brown & Barrow, Architects.

unison, will rather decrease than improve the sound; but if the bodies in contact with the air are in sympathy, it is otherwise. These facts can be usefully applied to our rooms, which may be taken to represent large bodies of air inclosed within walls (like the violin or organ-pipe), each with a note of its own that can be brought out with any appropriate sound bearing a relation to the pitch. By resonant materials, like wooden linings for walls and wooden ceilings, wood fittings, furniture and the like, the sounds will be improved in richness, every note sounded near will be intensified, and the materials so introduced will sound in unison. A hollow space under the floor and above the ceiling will greatly increase the resonance of a room, and for concert halls the orchestra should be constructed with hollow spaces around and below the floor, which will vibrate sympathetically with every note emitted. Where fire-resisting materials have to be introduced instead of wood linings and ceilings, metal lathing secured to uprights of iron or wood, upon which plaster or some other composition is laid, may be made to produce the same resonant effect; and the same result is attained by thin plates of metal used ornamentally as panels in the walls and ceilings. The use of furniture, pianofortes, organ-pipes, strained membranes like drumheads, and all wooden fittings; are useful expedients in producing resonance. Strings and rods can also be employed for the same purpose. We do not enter here into the subtle harmonical relation existing between the dimensions of a room and its musical or other sounding qualities, though it is quite possible to discover some ratio of height, width, and length, such as 1 : 2 : 4 that will create a musical note. We have not

sufficient data available as to the vibrations that are produced in large volumes of air, or the effects upon these which dimensions of the room and its shape may impress upon them. The "note" of any room will, of course, depend upon the number of vibrations, and it is presumable that good proportions will be advantageous. Many instances of harmonic proportion are known that favor this hypothesis. Resonance can be carried to excess and produce noise; but this is a fault that can be remedied by using absorbing materials such as we have indicated. A professor of physics at Harvard University has shown that the duration of the residual sound in a particular room is proportional inversely to the absorbing power of the absorbing walls and the contained material, and he proves this proposition by results obtained from data collected from various buildings.



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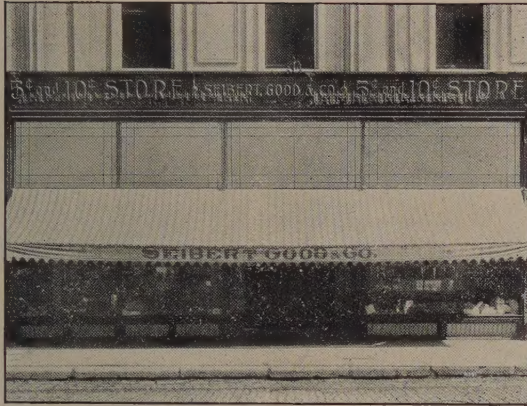
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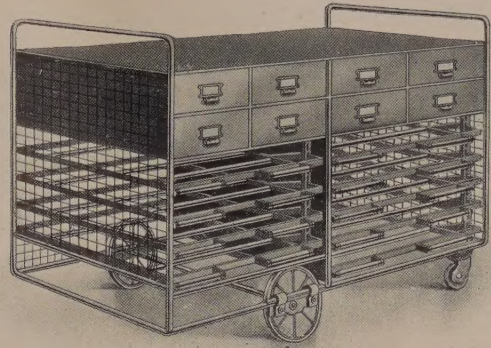
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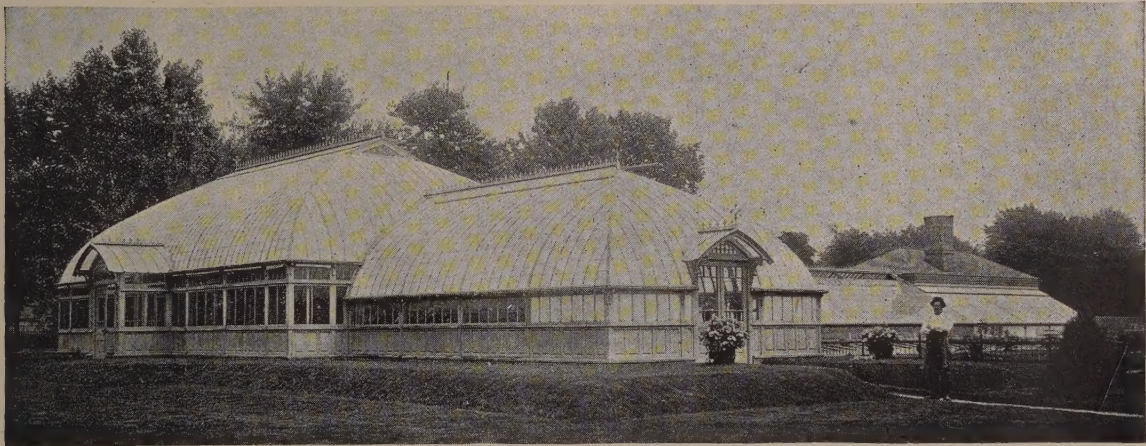
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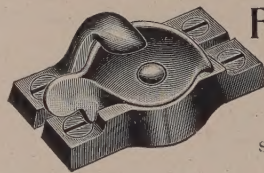
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